

UNIVERSITY OF PISA



MUSICAL STUDIES

PIETRO GROSSI

I - INSTRUCTION MANUAL

OF THE DCMP

*CNUCE*

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I - INSTRUCTION MANUAL  
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The D C M P (digital computer music program) memorizes a musical text either fed in or autogenerated and executes it

the sound is "built" in a register of the CENTRAL UNIT and from there conveyed by means of a cable to a normal amplifier for listening or recording

thus the phonic resources of the computer are employed without the aid of any other apparatus

the sound field consists of several thousands of frequencies rich with partial sounds whose duration can be regulated to more than or less than one period

numerous subroutines ensure a high level of operative flexibility both for the formulation and autogeneration of the text and also for the transformations which the memorized texts may undergo

the program is prepared for the IBM 360 System - Model 30 and Model 44 and for the IBM 7090 System

in the version for the 360 Series Models the data and the instructions may be transmitted also by console or by remote terminal

in the latter case the sound may be conveyed to the terminal by cable or by radio transmission

the D C M P is the first meaningful witness to the intense studies which are under way through the initiative of the CNUCE in order to use all the operative possibilities of the computer which may contribute to the evolution of the musical praxis, such as the elaboration of data, the direct output of sounds, the control of convertors and synthesizers

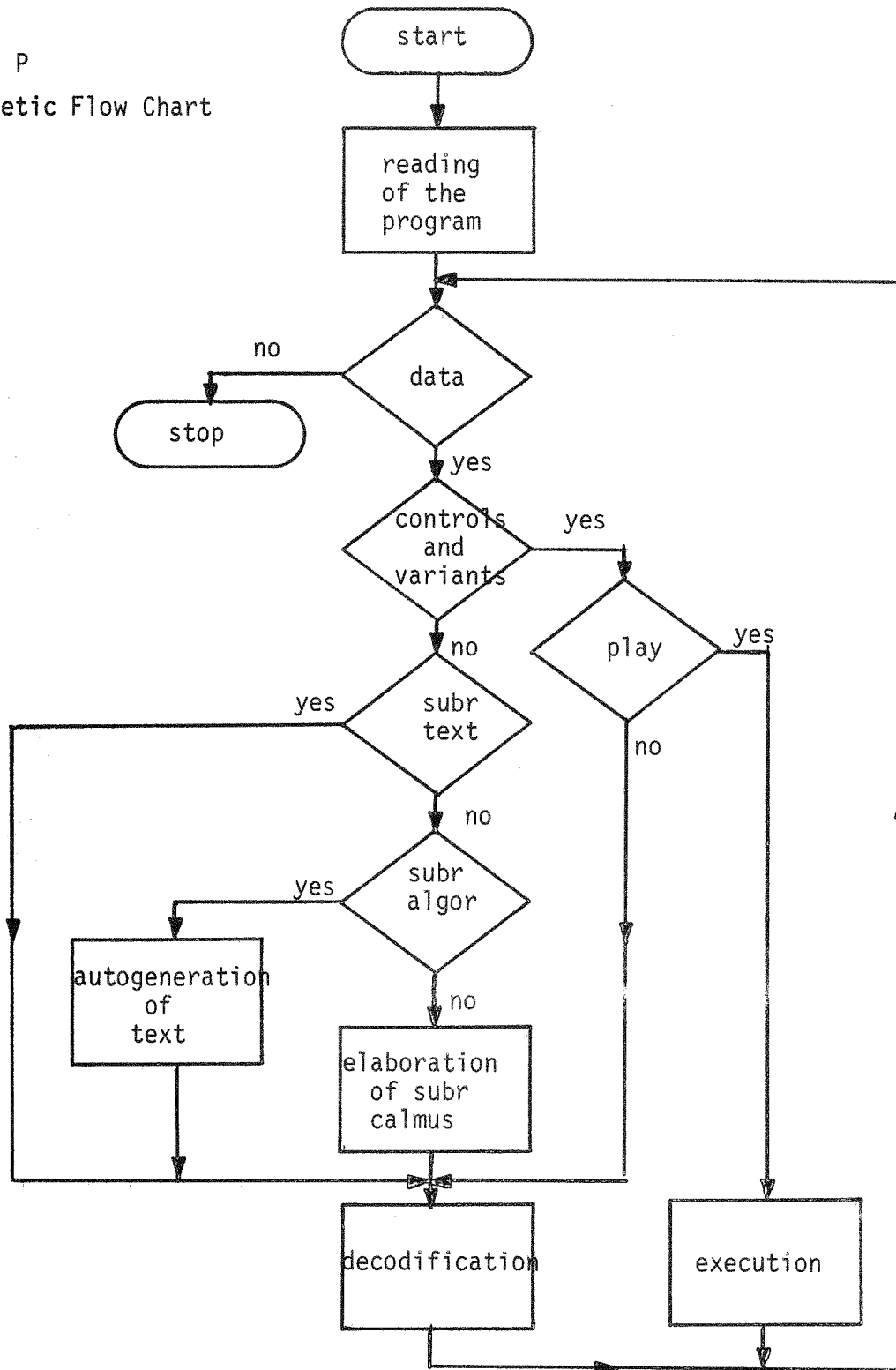
the D C M P has been planned and prepared by Cesare Chignoli, Pietro Grossi and Giorgio Sommi

Carlo Paoli has contributed to the programming

English translation by Anna M. Burney.

*Pisa, July 24, 1970/ns*

D C M P  
Synthetic Flow Chart



NØTES ØN THE D C M P

version for the IBM 360 System

the D C M P includes, in addition to the main program, 10 subroutines of decodification, elaboration and execution of a musical text partly compiled in FØRTRAN IV and partly in ASSEMBLER 360

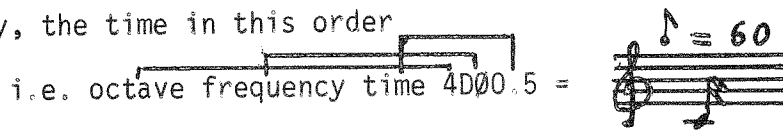
the notes deal with the parts of the main program and the subroutines which interest the user

NØTE: Ø = capital 0; 0 = zero

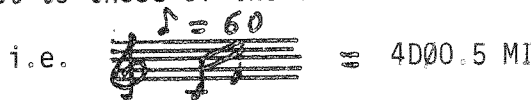
SUBROUTINE TEXT

decodification of a given musical text the interval ratios of which constituting the "well tempered" system are equal to  $\sqrt[12]{2} = 1.05946$  or the powers of this number

each sound must be expressed by 3 parameters concerning the octave, the frequency, the time in this order

i.e.  =

the parameters "octave" and "time" may be omitted if they remain unvaried in respect to those of the sound immediately preceding them

i.e.  = 4D00.5 MI

the octave should be expressed by a number between 0 and 9

each octave begins with the sound D0

the basic reference is 4LA, that is 440 HZ

the extreme limits are

0D0 and 9SI (the latter only if the computer permits it)

table of the initial sounds of the 10 octaves:

0D0 (16.35 HZ)	5D0 (523.2 HZ)
1D0 (32.70 " )	6D0 (1046 " )
2D0 (65.40 " )	7D0 (2093 " )
3D0 (130.8 " )	8D0 (4185 " )
4D0 (261.6 " )	9D0 (8370 " )

the frequency may be expressed in Latin or English codes

the following letter combinations are possible:

Latin code - D0,D0B,D0D,RE,REB,RED,MI,MIB,MID, FA,FAB,FAD,  
S0L,S0LB,S0LD,LA,LAB,LAD,SI,SIB,SID

English code - C,CF,CS,D,DF,DS,E,EF,ES,F,FF,FS,G,GF,GS,A,  
AF,AS,B,BF,BS

the combinations ending in B and D (Latin code) and F and S (English code) indicate respectively the raising and the lowering of a semitone of the sound to which the radical of the sound itself refers

a rest should be indicated by the letter P which will take the place of the name of the note

i.e.  = 5D02. P1. 4S0L

the time should be expressed by a fraction or a decimal number

in assigning the value one should consider that 1. is equivalent to the duration of one second

if the number has no decimal values, the period may be omitted

if the number at the right or at the left of the period is equal to zero it may be omitted

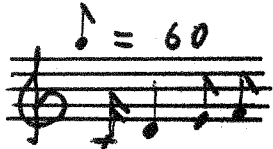
the period may be omitted only if the number at the right is equal to zero

i.e. 3.0;0.25; 4. or 3; .25; 4

in fractions the figure should not be followed by a period and the dividend 1 may be omitted

i.e. 1/3 or /3

the Latin and English codes, and the fractions and decimal numbers may be combined

i.e. 4D00.5 D2. E1 FA ]  
or 4C.5 RE2 MI1. F ] = 

## RULES FØR FEEDING THE MUSICAL TEXT INTO THE CØMPUTER

the text may be fed in by card or console

### BY CARD

a card must be perforated within the positions between 1 and 72 and it may contain the parameters of one or more sounds separated in turn by one or more spaces

the parameters of the same sound must be contained in one card and must not be separated by spaces

an asterisk must be perforated at the end of the text and separated from the last sound by at least one space

### BY CØNSØLE \*

lines up to 120 characters long may be employed

each line may contain the parameters of one or more sounds separated by one or more spaces at the end of each sound

the parameters of the same sound should be typed on the same line and should not be separated by spaces

an asterisk should be typed at the end of the text and separated from the last sound by at least one space

the feeding of the text must be preceded by the word TEXT if by console, and TEXT CARD (typed at the console) if by card

eventual errors will be indicated by the console

\*the command "end of block" should always follow an instruction or a list of data

in any case it should always be typed for the line change



## SUBROUTINE ALGØR

automatic elaboration of a musical text by means of algorithms contained in the subroutine

23 alternatives are available - to be employed individually or combined - for the modification of the operative process

the subroutine acts within 5500 frequencies, whose limits are 1 and 4900.5 HZ, and the same number of durations within 1/100 of a second and 9.9 seconds (these limits may be exceeded by use of the alternatives)

the choice, the order and the repetition of the two parameters are entrusted to the algorithms of the subroutine

the level of prevision on the elaborated values depends on the employment criteria of the alternatives

LIST OF ALTERNATIVES

function	number of figures		symbol
	whole	decimal	
1) duration in seconds	1 ÷ 5(°)	0	/D1/
2) duration in number of sounds	1 ÷ 5(°)	0	/D2/
3) number with 4 figures (°°)	4	0	/N1/
3a) " " " " (°°)	4	0	/N2/
4) rectification of the frequency values	1	2	/F1/
5) automatic research of the fields of frequency within which the subroutine will rectify the frequencies	1	0	/F2/
6) assignment of the highest value to a field of frequencies	1 ÷ 5	0	/F3/
7) assignment of the minimal value to a field of frequencies	1 ÷ 5	0	/F4/
8) automatic research of the interval ratios	1	0	/F5/
9) assignment of the interval ratio	1	4	/F6/
10) inversion of intervals	1	0	/F7/
11) rectification of the time values	1	2	/T1/

(°) in theory, since there is a limit given by the computer

(°°) alternatives 3 and 3a are to be considered one alternative and as a consequence employed together - the values assigned determine the structural characteristics of the elaboration

LIST OF ALTERNATIVES (continued)

function	number of figures		symbol
	whole	decimal	
12) automatic research of the time values within which the subroutine will rectify the times	1	0	/T2/
13) assignment of the highest value of a time field	1	2	/T3/
14) assignment of the minimal value to a time field	1	2	/T4/
15) automatic research of the metric unit	1	0	/T5/
16) assignment of the value of the metric unit	1	2	/T6/
17) inversion of the time ratios	1	0	/T7/
18) automatic research of rests	1	0	/P1/
19) inversion of the data of the preceding research (a sound in the place of a rest and viceversa)	1	0	/P2/
20) percentage of rests	3	0	/P3/
21) periodic rests	3	0	/P4/
22) inversion of the data of the preceding research (a sound in the place of a rest and viceversa)	1	0	/P5/
23) repetition of the elaboration	3	0	/K1/

NOTE:

- a) in the case of a lack of alternatives concerning the duration, the subroutine will elaborate a certain number of sounds depending on the computer employed - the 360 computers mod. 30 and mod. 44 may elaborate 2000 and 7000 sounds respectively
- b) in the alternatives with a decimal number different from zero a period should be placed after the whole figure which may also be equal to zero and therefore omitted
- c) if the alternative is formed by a whole number and zero decimal any number different from zero can be assigned
- d) the assignment of value to /K1/ should be different and higher than 1.

LIST OF ALTERNATIVES NOT TO BE COMBINED (cases in which the subroutine elaborates only one of the given alternatives)

function	alternatives	
1) duration of the elaboration	/D1/ and /D2/	the subroutine elaborates only /D1/ provided that the elaboration does not exceed the highest number of sounds which can be elaborated by the computer otherwise the elaboration is stopped at the highest number
2) rectification of frequencies	/F2/ annuls /F3/ and /F4/	
3) rectification of frequencies	/F5/ " /F6/	
4) rectification of times	/T2/ " /T3/ and /T4/	
5) rectification of times	/T5/ " /T6/	
6) research of rests	/P4/ " /P1/, /P2/, /P3/	
7) " " "	/P3/ " /P1/ and /P2/	

NOTE:

/P2/ and /P5/ should be employed respectively and only together with /P1/ and /P4/

## RULES FØR THE FEEDING ØF DATA

### BY CØNSØLE

- 1) type the word ALGØR
  - after this instruction the console prints the symbols of the first 10 alternatives
- 2) assign the value to the alternatives in line separating each value by means of a comma
  - after printing the values assigned, the console prints the symbols of the other 13 alternatives
- 3) assign the value to the printed alternatives

### NØTE:

- a) the assignment of values to the alternatives is optional
- b) in case of an error signalled by the console, the wrong instruction may be corrected and typed again
- c) after executing the elaboration the console requests eventual modifications by means of the light PRØCEED
- d) the modifications may be given in sparse order indicating with the proper symbol the alternative chosen
- e) the output of the subroutine is obtained by printing ØUT in place of the modifications

RULES FOR THE FEEDING OF DATA (continued)

BY CARD

- 1) type the word ALGOR CARD at the console
- 2) two cards should always be introduced which contain the data concerning the eventual alternatives
- 3) the FIRST card should contain the data of the first 10 alternatives and the SECOND the data of the remaining 13 alternatives
- 4) both ON THE CARD and AT THE CONSOLE a comma should be placed in the following cases:
  - a) between two alternatives if more than one is used
  - b) to indicate the blank alternatives at the left of the alternative used
  - c) to indicate the blank alternatives between two or more alternatives used in the same line or card

i.e. /D1/60,,,/F2/1,,,/F5/1 (data for the 1st line or card)  
    ,,/T3/0.5,/T4/0.03,,,/P1/1 (data for the 2nd line or card)
- 5) after the first elaboration the alternatives should be given solely BY CONSOLE . THE WORD CONSOLE SHOULD PRECEDE THE ALTERNATIVE

RULES FØR A SIMPLIFIED USE ØF SUBRØUTINE ALGØR

(solely by console)

- 1) type the letter A (call of the subroutine)
- 2) (optional operation) print any number of letters, either repeating them or not, in any order and quantity, provided they do not exceed one printed line (120 characters)
- 3) type the special character = (output of the subroutine)
- 4) in case the printing of the elaborated data is desired, type the special character \*



SUBROUTINE CALMUS

empty subroutine available to the user who may insert a series of instructions in order to obtain the numerical data of sequencies and durations

this subroutine should be preceded by the word CREATE typed at the console or perforated on a card

the data will be converted into sounds by the proper subroutine preceding the execution of the texts

## CØNTRØLS

the texts of the three subroutines TEXT, ALGØR, CALMUS may be kept and recalled in addition to being executed, by means of the following instructions:

### 1) PLAY (execution of the text)

type the word at the console and, in case a repetition of the execution is desired, type a number the value of which should correspond to the number of repetitions desired (not inferior to 2)

### 2) SAVE (conservation of the text)

type at the console the word followed by a name or a symbol devised to recognize the text

### 3) LØAD (research of the text)

type at the console the word, followed by the name or symbol of the recalled text

### 4) CHAIN (connection of a text to another immediately preceding)

type at the console the word followed by the name of the text to be connected

## VARIANTS

instructions which modify totally or partially the parameters of frequency and time of a memorized text

the instructions consist of a word which defines the type of modification and a series of parameters whose number varies according to the type of modification

## LIST OF PARAMETERS

(the following symbols are used in this list to facilitate the recognition of the corresponding parameters. They should never be printed)

1) R (decimal number)

it multiplies the frequency - if the number is negative the sound will be substituted by a rest - if = 0, R = 1.

2) S (decimal number)

it multiplies the duration - if = 0, S will be = 1.

3) L1 (whole number)

it indicates the number of the sound from which the variation originates  
- if = 0 or = 1 the variation begins with the first sound

4) L2 (whole number)

it indicates the order number of the sound with which the variation ends -  
if = 0 the variation continues until the end of the text

5) P (whole number)

it defines the recurrency of the variation within the limits assigned by the two preceding parameters

if = 0 or = 1 all the sounds will be modified

if = 2 every 2nd sound will be modified

if = 3 every 3rd sound " " "

and so on

TABLE OF THE VARIANTS AND OF THE ASSOCIATED PARAMETERS

MØDIFY	R, S, L1, L2, P global or individual modification of frequencies and times
SCALE	R, S, L1, L2, P modification of the value of the radical whose root 12 will constitute the basic value for the research of the intervals the value may be assigned to the 1st parameter or to the 2nd assigning the value 2. to the 1st
INVERT	inversion of the order of the sounds of a memorized text
CØMPLEM	R, S global or individual inversion of the interval ratios and the temporal ratios
SHUFFLE	R restructuring of a memorized text the characteristics of the re-elaboration depend on the value of the number which should be in four figures and a whole number

## RULES FOR THE FEEDING OF DATA

### BY CONSOLE

the word corresponding to the desired modification is printed and, according to the order indicated in the table, the values of the parameters separated by a comma are also printed

as in the case of the alternatives of the subroutine ALGOR a comma should be printed for the parameters at the left of the last one used

i.e. 2.,,10,,3 = (R)2.,(S)1.,(L1)10,(L2)N,(P)3  
      ,0.5,,100 = (R)1.,(S)0.5,(L1)1,(L2)100,(P)1

### BY CARD

the word should be perforated starting from the first position and the parameters should be employed according to the regulations given for the feeding by console

## NOTES ON THE D C M P

version for the IBM 7090 System

this version differs from the preceding solely in the rules for the feeding of data and instructions, that is:

- 1) the data and the commands are fed solely by card
- 2) the call words of the subroutines and those referring to the controls and the variations are substituted according to the following table:

360 system	7090 system
TEXT CARD	LEGGI
ALGØR	ALGØR
CREATE	CREA
PLAY	SUONA
SAVE	SALVA
LØAD	CERCA
CHAIN	LEGA
MØDIFY	VARIA
SCALE	SCALA
INVERT	INVERT
CØMPLEM	CØMPL
SHUFFLE	RIFAI

RULES ON THE FORMAT OF THE DATA CARDS

subroutine LEGGI

no variation in the format of the parameters of the sound

the asterisk indicating the end of the text must be perforated on a card devoid of any other perforation

subroutine ALGØR

format of the data card

1	5	6	10	11	18	19	22	23	24	28	29	33	34	35	40	41	42	45
D1		D2		(N1,N2)		F1		F2	F3		F4		F5		F6	F7	T1	

46	47	50	51	54	55	56	59	60	61	62	63	65	66	68	69	70	72
T2		T3		T4	T5		T6	T7	P1	P2		P3		P4	P5		K1

the output of the subroutine is given by the number 99999 perforated in the position 1 ÷ 5 of a card devoid of any other perforation

subroutine CALMUS

no variant

CONTROLS

format of the controls with a parameter

1		WORD	5	6
---	--	------	---	---

32	33		NAME	38	39
----	----	--	------	----	----

## VARIANTS

format

1	5	6	11	12	17	18	22	23	27	28	32	33
WØRD		R		S		L1		12		P		

### NØTE:

all the words with or without parameters must be perforated in the position 1 ÷ 5